physical sciences

Molecules in Orion

The infrared nebula in the constellation Orion, called Ori A, is one of the locations in the sky where a sizable variety of chemical compounds coexist. Recently a variety of formaldehyde (H_2CO) not previously seen in interstellar space, para-formaldehyde, has been found there.

In para-formaldehyde the spins of the two hydrogen atoms are in opposite directions; in the other form, ortho-formaldehyde, the hydrogen spins are in the same direction. The difference affects the energy levels of the electrons and consequently the radio frequencies the molecules emit. Para-formaldehyde is reported in the Sept. 1 ASTROPHYSICAL JOURNAL LETTERS by Patrick Thaddeus of Columbia University, R. W. Wilson of Bell Telephone Laboratories, Marc Kutner of Columbia and A. A. Penzias and K. B. Jefferts of Bell Labs.

In ASTROPHYSICAL JOURNAL LETTERS for Sept. 15 A. H. Barrett, P. R. Schwartz and J. W. Waters of Massachusetts Institute of Technology report the discovery of methyl alcohol (CH_3OH) in Ori A. In contrast to other species found in Ori A—formaldehyde, carbon monosulfide (CS), carbon monoxide (CO), hydrogen cyanide (HCN)—which appear to inhabit a region three minutes of arc or more across, the methyl alcohol emission comes from a region less than one minute across. "It is tempting to speculate that the more complex molecules are formed in the central region of the infrared nebula where the density is significantly higher," the MIT scientists write.

A black hole in beta Lyrae?

The masses of the two components of the eclipsing binary star system, beta Lyrae, have been a source of puzzlement and controversy for a long time. Controversy rages over how much of the system's mass is in each component and how any chosen masses can be reconciled with the luminosity or lack of it of either component.

Edward J. Devinney Jr. of the University of South Florida has used photometric data to arrive at an estimate of the masses. He finds that most of the mass, about two-thirds, is in the dark secondary. On the basis of this ratio, the secondary's mass is about 20 times that of the sun, the bright primary's about 10 times that of the sun.

This conclusion means that the secondary is at least four magnitudes darker than a star of its mass ought to be. Devinney suggests that it may be a black hole surrounded by a disk of matter ejected as it collapsed.

The island of superheavy nuclei

If the known varieties of atomic nuclei are arranged on a graph in which one coordinate is the number of neutrons and the other the number of protons, the stable species fall along a long thin peninsula running at an angle across the page from hydrogen (1p, 0n) to uranium (92p, 146n). Around the peninsula is located the sea of instability, combinations of neutrons and protons that either do not exist or do not last.

Various theoretical arguments have led to the belief that an island of stability exists somewhere off the tip of the peninsula and is the home of relatively stable superheavy nuclei. Calculations by Mark Bolsterli, E. O. Fiset, J. R. Nix and J. L. Norton of the Los Alamos Scientific Laboratory have charted the island, and its geography is reported in the Sept. 6 PHYSICAL REVIEW LETTERS.

With respect to spontaneous fission, the island is a distorted diamond shape. Its center is a mountain ridge at about 184 neutrons extending from 114 protons to about 124 protons, representing the species most likely to resist fission. The descent to the sea of instability is gentle for neutron numbers decreasing from 184, but more rapid on the other sides of the island.

As a result of their calculations, the Los Alamos group warn that experiments trying to make superheavy nuclei by striking smaller nuclei together will find it impossible to hit the center of the island. It is probably better, they say, to try for proton numbers beyond 114 and more than 184 neutrons.

X-ray sources in the Magellanic Clouds

X-ray astronomers, who have found a number of discrete sources of X-rays in our galaxy, now may have found some in two external galaxies. Equipment aboard the Uhuru satellite has found three discrete sources in the direction of the Large Magellanic Cloud and one in the direction of the Small Cloud, according to a report submitted to the ASTROPHYSICAL JOURNAL by C. Leong, Edwin M. Kellogg, Herbert Gursky, H. Tananbaum and Riccardo Giacconi of American Science and Engineering, Inc., in Cambridge, Mass.

A number of galaxies that emit X-rays are known, but in most of them the emission comes from the galaxy as a whole and the distance is too great to resolve individual sources. The Magellanic Clouds are the nearest galaxies to our own and thus the most likely candidate for resolution of individual sources.

Observation of the new discrete sources in a region of the sky where the Clouds are the most prominent objects and the density of stars and radio sources in our own galaxy is very low leads the AS&E group to suggest that the new sources are indeed in the Clouds.

Natural plutonium found

For decades uranium has been regarded as the heaviest element found in nature. Now it has been dethroned: The most stable isotope of plutonium, 244, has been found in an old California ore.

The plutonium 244 was discovered in bastnasite ore mined by the Molybdenum Corp. of America in the company's Mountain Pass Mine in southern California. Darleane Hoffman and Francine Lawrence of the Los Alamos Scientific Laboratory and Jack Mewherter and Frank Rourke of the Knolls Atomic Power Laboratory isolated about 20 million atoms, less than one-hundreth of a microgram, from an organic solvent concentrate prepared from nearly 200 pounds of bastnasite.

Plutonium 244 has a half-life of 80 million years. This is short compared to geologic times, and the presence of detectable amounts in mineral deposits lends support to the hypothesis that the heavy elements were formed at about the time the solar system was formed rather than much earlier.